Spectral Analysis of Shadow Window-FIR Filters

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Abstract— The spectral analysis of signals are very essential when they are interpretation, In this aspect Window technique is the one of the best tool to analyze the signals. Here we proposed a new window, to it introduced a shadow window concept i.e. feed back to get to achieve better spectral Parameter values than proposed window. And comparison is made with respect to the side lobe attenuation and main lobe width(band width).Low pass filter responses also introduced with the proposed window with a cut off frequency of 0.2π

Index Terms: Shadow mechanisim,low pass filter,MATLAB tool.

I. Introduction

In literature many windows have been proposed like Rectangle window, Triangular Window,Hamming and Hanning window with different specifications[1]. But since they are suboptimal solutions, as there is a tradeoff between various factors and the best window depends upon the related application. The main-lobe width determines the ability to resolve adjacent spectral lines. Side-lobe is another spectral parameter and important for many applications. For beam forming applications, the higher side-lobe means that it can reject the far end interferences better.

II. Introduction to The Proposed Window

The Proposed Window is Expressed as [2]

$$w(n) = 4 - t^2 \quad for \ -2 \le t \le 2$$

= 0 otherwise. (1)

The frequency domain characteristics of Proposed window shows that the main lobe width and side lobe attenuation as shown in fig1.and spectral parameters are tabulated in Table-I.

A. Modified Proposed Window

The modified proposed window is obtained by introducing power 5.3 to proposed window which is shown in Fig:2 and it's spectral parameters are tabulated in Table-I.

III. Proposed shadow mechanism

In shadow window mechanism the base window out put is feedback positively or negatively by a shadow window of same type or different type .[2] Here we used the shadow mechanism to find best combination for different values of 'a' for which the side lobe attenuation is less.

To achieve that we can use any combinations like low

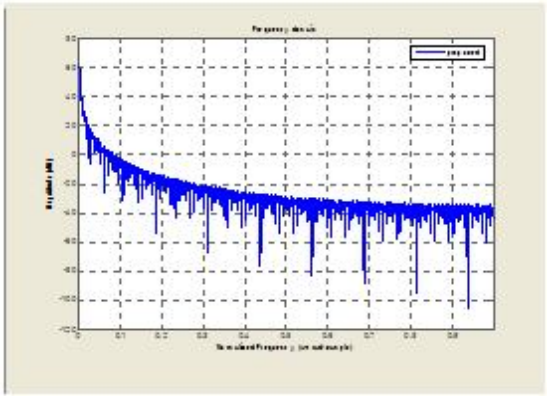

Fig1:Response of proposed window

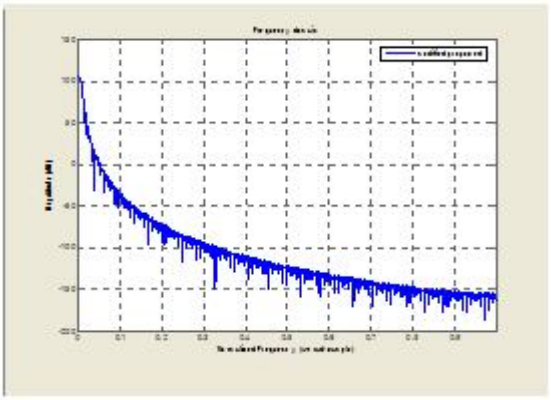

Fig2:Response of modified proposed window

TableI. parameters of proposed window

Window	Side lobe attenuation in dB	Main lobe width in dB
Proposed	-21.3	0.0106
Modified Proposed	-44.7	0.0108

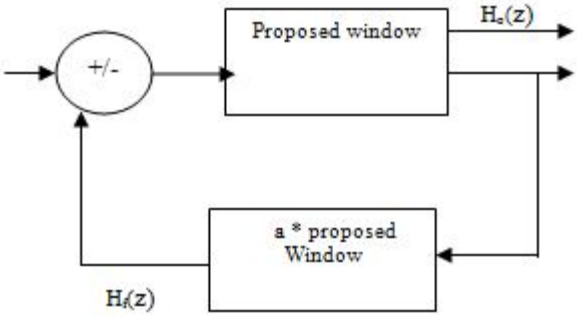

Fig.3(Block diagram for Shadow Window mechanism)

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pass in main path and high pass in feedback path, which is shown in fig:3. Hence we can derive expression of the transfer function for the shadow mechanism with negative feed back connection is,

$$H_c(Z) = \frac{The\ transfer\ function\ of\ proposed\ window}{1 + a * (Transfer\ function\ of\ shadow\ wiindow)}$$

Similarly for positive feedback connection

$$H_0(z) = \frac{The\ transfer\ function\ of\ proposed\ window}{1 - a * (The\ transfer\ function\ of\ shadow\ window)}$$

Where a is a numeric constant.

IV. Implementation of Shadow Window

Mat LabSimulation Results Proposed window in main path and same window in positive feed back connection ,and it's spectral responses are shown in Fig -4 and Fig-5 for different values of 'a', and it's spectral parameters are Tabulated in Table-II.

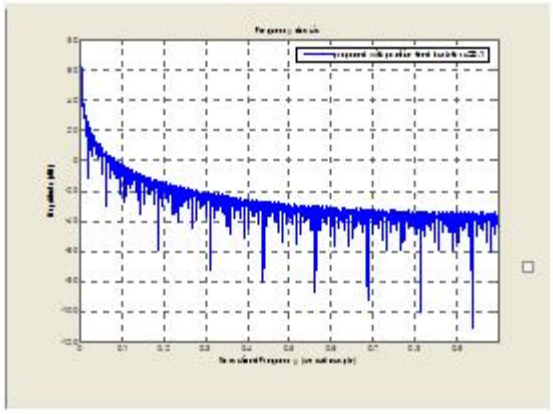

Fig4:Response of proposed window with positive feed back for a=0.1

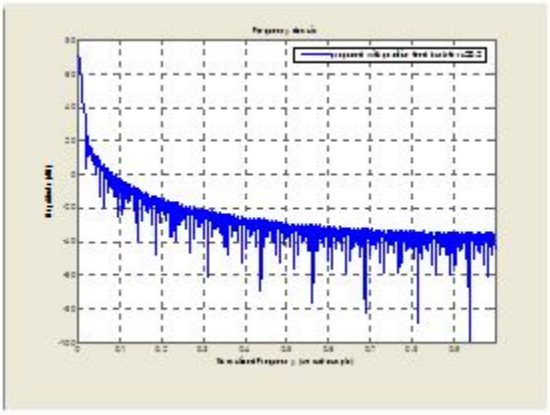

Fig5:Response of proposed window with positive feed back for a= 0.2

Table-II: parameters of shadow window

A	Relative Side Lobe Attenuation(dB)	Main lobe width (dB)
0.1	-26.3	0.0101
0.2	-47	0.0143

V. Implementation of Low pass filter by using shadow Window

To study the efficiency of the proposed window we have compared the results by observing the Fourier Transform of a low pass FIR filter designed by truncating of an ideal IIR low pass filter. [3] ,[4] Having a cut off frequency of ω_c. The impulse response of an ideal low pass filter is:

$$h(n) = \frac{\sin w_c \pi n}{\pi n} - (2)$$

By windowing this IIR filter with the windows discussed in this paper, different FIR filters can be obtained.

With cut off frequency $\omega_c = 0.2\pi$

Frequency response of fir-low pass filter for different different window lengths which are shown in fig6 to figs8.nad it's spectral parameters are tabulated in Table-III

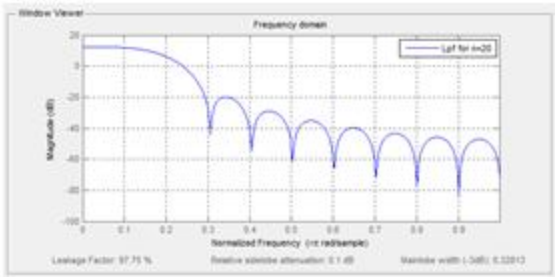

Fig-6 Response of LPF for n=20

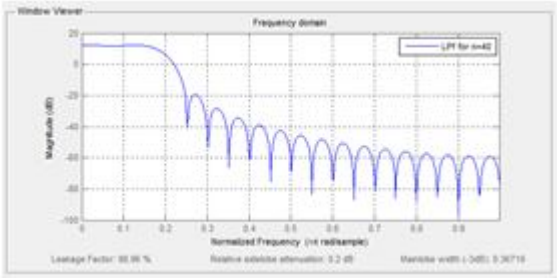

Fig7:Response of LPF for n=40

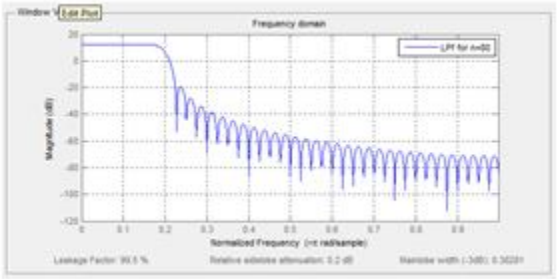

Fig8:Response of LPF for n=80

Table-III:parameters of low pass filter

n	Relative Side Lobe Attenuation(dB)	Main lobe width (dB)
20	-32.11	0.6562
40	-32.58	0.7342
60	-40	0.7656

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VI. Conclusion

The proposed window gives better sharper in Main lobe width, and side lobe attenuation is more than Boxcar window and lower than batlett.i.e. interms of -8 dB and -4.7dB respectively. And modified proposed window almost falls hanning window i.e. -44.7 dB.by introducing feed back to the proposed window the side lobe attenuations are increased to -26.3 dB and -47dB for 'a'=0.1 and 'a'=0.2 Respectivily.Thus the shadow feed back concept fulfills to get maximum Side lobe Attenuation.

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P.V.Muralidhaar obtained M. Tech from JNTU, Hyderabad, pursuing phd form Berhampur University. He is having an experience more than 10 years and also having more number of both national and international journals, conferences. His area of interest is signal processing,presently working with AITAM , Tekkali, Srikakulam, A.P

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